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CASTILLEJA COLLEGIORUM (OROBANCHACEAE), A NEW SPECIES FROM THE CASCADE MOUNTAINS OF SOUTHERN OREGON, AND THE STATUS OF *CASTILLEJA LASSENENSIS* EASTW.

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ABSTRACT

Castilleja collegiorum J.M. Egger and S. Malaby, **sp. nov.**, is described from the Cascade Mountains of southwestern Oregon (Klamath County), where it is found in seasonally wet meadows. While the new species is locally fairly common, it is a narrow endemic and its conservation status is in need of monitoring. *Castilleja collegiorum* most closely resembles *C. lemmonii* (in details of the floral morphology) and *C. cryptantha* (in the patterns of coloration in the inflorescence and in growth form). It is perhaps derived from or most closely related to *C. lemmonii*. The status of *Castilleja lassenensis* Eastw. is also discussed, and its resurrection as a distinct species is proposed, based on its consistent morphological differences and geographical disjunction from typical *C. lemmonii* in the Sierra Nevada.

The new species described here was first observed during vegetative surveys for the Winema National Forest in the 1990's (U.S. Forest Service, unpubl. data), during which it was mistaken for *Castilleja pilosa* (S. Wats.) Rydb. Subsequent visits by agency botanists overlooked it while focused on *Gentiana newberryi* A. Gray, a species with a later blooming period. In mid July 2012, Malaby visited Big Meadows looking for another rare species, *Carex capitata* L., and noticed the presence of a *Castilleja* species she had not encountered previously. While it appeared in some ways similar to *C. lemmonii* A. Gray, it differed considerably from that California endemic species, known from the Sierra Nevada and from the vicinity of Mt. Lassen, especially in coloration and in several morphological characters of the leaves, calyces, and corollas. Malaby then sent specimens of the unusual *Castilleja* to Robert Meinke (OSC), who equivocally identified them as aberrant *C. lemmonii*. Forest Service botanist Missy Anderson subsequently sent specimens and photos gathered by Malaby to Egger for further evaluation. Egger confirmed that the plants in question displayed a suite of characters clearly differentiating it from *C. lemmonii* and proposed that it might represent an undescribed species. Egger visited the site with Malaby on 25 July 2014, confirmed the novelty of the species, and obtained the type collection.

CASTILLEJA COLLEGIORUM J.M. Egger & S. Malaby, **sp. nov.** (Figs. 1-3). **TYPE: USA. Oregon.** Klamath Co.: Fremont-Winema National Forest, eastern Cascade Mountains, Big Meadows, W of Pelican Butte, T35S R5E sec 14 and 11, drier margins and hummocks of seasonally wet, loamy meadow complex, ca. 5650 ft. (ca. 1720 m), 25 Jul 2014, *M. Egger 1540 & S. Malaby* (holotype: WTU; isotypes: CAS, GH, K, MO, NY, OSC, P, RM, UC, US).

Most closely resembling to *Castilleja lemmonii* A. Gray (in details of the floral morphology) and *Castilleja cryptantha* Pennell & G.N. Jones (in the patterns of coloration in the inflorescence and in growth form) but differing from both in its consistent combination of the following characters: inflorescences slender, somewhat elongated and non-capitate, the bracts gradually and weakly

differentiated from the leaves; pale cream-white or pale greenish-yellow base coloration of the calyces and bracts, with varying infusions of dull maroon to pale reddish-violet pigments in the bracts and calyces, especially with age; main cauline leaves with a pair of divaricate-ascending, linear-lanceolate, distally acute lobes; the bracts appearing to be significantly shorter than the flowers; calyces 11–20 mm long, with short segments, 0.5–1.5 mm in length; corollas 18–25 mm long, with the beak about twice the length of the lower lip, the latter having whitish, linear-lanceolate distal teeth.

Plants perennial, branching from slender, woody, often taprooted caudices. **Stems** few to many, most plants producing 6–18 flowering stems, unbranched, short-decumbent proximally, quickly becoming upright-ascending distally, 15–28 cm long when mature, dull greenish to dull reddish, villosulous with thin, multicellular, usually minutely stipitate-glandular hairs. **Leaves** narrow, sessile, upright-ascending, 15–35 mm long, 2–13 mm wide, linear to linear-lanceolate, distally acute-tipped, pale greenish to dull reddish-maroon, sparsely villosulous with a mixture of stipitate-glandular hairs and non-glandular hairs, often entire proximally but always becoming divided and 3-lobed for at least the distal 2/3 of the stem, the spreading to ascending lateral lobes usually branching from the distal half of the blade, linear-lanceolate, acute-tipped, and usually shorter and narrower than the central lobe. **Inflorescences** narrow, often elongated, racmiform spikes, not strongly differentiated from the leaves, 4–10 cm long, 0.5–20(–25) cm wide in mid-flowering, elongating somewhat with age; flowers few to many, sessile; prominent coloration borne both on bracts and calyces, with the base color pale cream-white to pale greenish-yellow, but this often partly to entirely suffused with dull reddish-violet to maroon, especially proximally, along veins, and with age (Figs. 5-6). **Bracts** gradually and weakly differentiated from the leaves, more or less narrowly lanceolate, 10–20 mm long, 2–8 mm wide, usually appearing to be shorter than the flowers, almost always divided from above mid-blade into 3 acute-tipped lobes, the central lobe lanceolate, and the lateral lobes linear-lanceolate and shorter; pubescent with a fairly dense indument of villosulous hairs, some of which are minutely stipitate-glandular; base coloration pale cream to pale greenish-yellow, but this often partly to entirely suffused with dull reddish-violet to dull maroon, especially proximally, along veins, and with age. **Calyces** 11–20 mm long, divided adaxially and abaxially into two subequal primary lobes 7–12 mm in length, each of these distally shallowly cleft into two triangular, acute to obtuse segments, each 0.5–1.5 mm in length; usually pale greenish proximally becoming whitish on the distal segments, sometimes reddish-violet to maroon distally and/or with a thin vertical stripe of pale reddish-violet; minutely puberulent with mostly non-glandular hairs. **Corollas** 18–25 mm long; subglabrous to minutely puberulent; beaks 6–7 mm long, adaxial surface pale greenish to pale cream with the thin margins unpigmented or sometimes with a faint blush of pale reddish; lower lip about 3 mm long, consisting of three fused, longitudinally grooved and bilobed, uninflated, greenish pouches, about 2 mm long, from each of which emerges a linear-lanceolate, slightly incurved, white tooth, about 1 mm in length. **Stigmas** barely exserted from the calyces, subcapitate to minutely bilobed, greenish. **Anthers** mostly included within and dehising from the thin margins of the corolla beak, filaments glabrous. **Capsules** 7–10 mm long, 3–4 mm wide, narrowly ellipsoid with a slightly curved, acuminate tip, medium brown, glabrous. **Seeds** 20–30 per capsule, 1–2 mm long, ovoid, pale white; coat loose-fitting, very shallowly reticulate, cells mostly polygonal-ovate; radial walls membranous, smooth and unstriated; inner tangential walls membranous and ruptured to less commonly unruptured at maturity.

Castilleja collegiorum is named in celebration of the modern collaboration of botanists of many standings in the advancement of the science to which we all are dedicated, incorporating the knowledge and contributions of amateurs, field botanists, agency personnel, collections managers, and professional botanists alike.

Additional specimen examined. USA. Oregon: Klamath Co.: Fremont-Winema National Forest, Klamath Ranger District, Cascade Mountains, Big Meadows, 5650 ft, 15 Jul 2013, *S. Malaby s.n.* (WTU).

Figure 1. *Castilleja collegiorum* in the field, Big Meadows, Klamath Co., Oregon, 15 Jul 2013. All photos of *C. collegiorum* in the field by Sarah Malaby.

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cm
HOLOTYPE! of:
Castilleja collegiorum J.M. Egger & S. Malaby
Determined by Mark Egger, 2003-2004
University of Washington
SEEDS
Castilleja collegiorum, sp. nov. J.M. Egger & S. Malaby
var. ssp.
Family Orobanchaceae
25 Jul 2014
Location Around forested "island" within and along margins of Big Meadow, via Cold Springs TH road 3651, W on forest road 3659, N on 080 spur to meadow, Klamath Ranger District, eastern Cascade Mountains, T26S, R9E,Sec 23, SE1/4 of NW1/4.
Jurisdiction Fremont-Winema National Forest
County Klamath
State OR
Country
Elevation 5650'
Habitat Patchy distribution, generally in a narrow band above wet sedge/hairgrass community up to forested edge of meadow.
Color Calyces pale white to yellowish-green; bracts mostly dull reddish-brown
Notes HOLOTYPE; locally common.
J. M Egger & S. Malaby 1540
Distribution WTU
Photo? y

Figure 2. Holotype of *Castilleja collegiorum*, WTU.

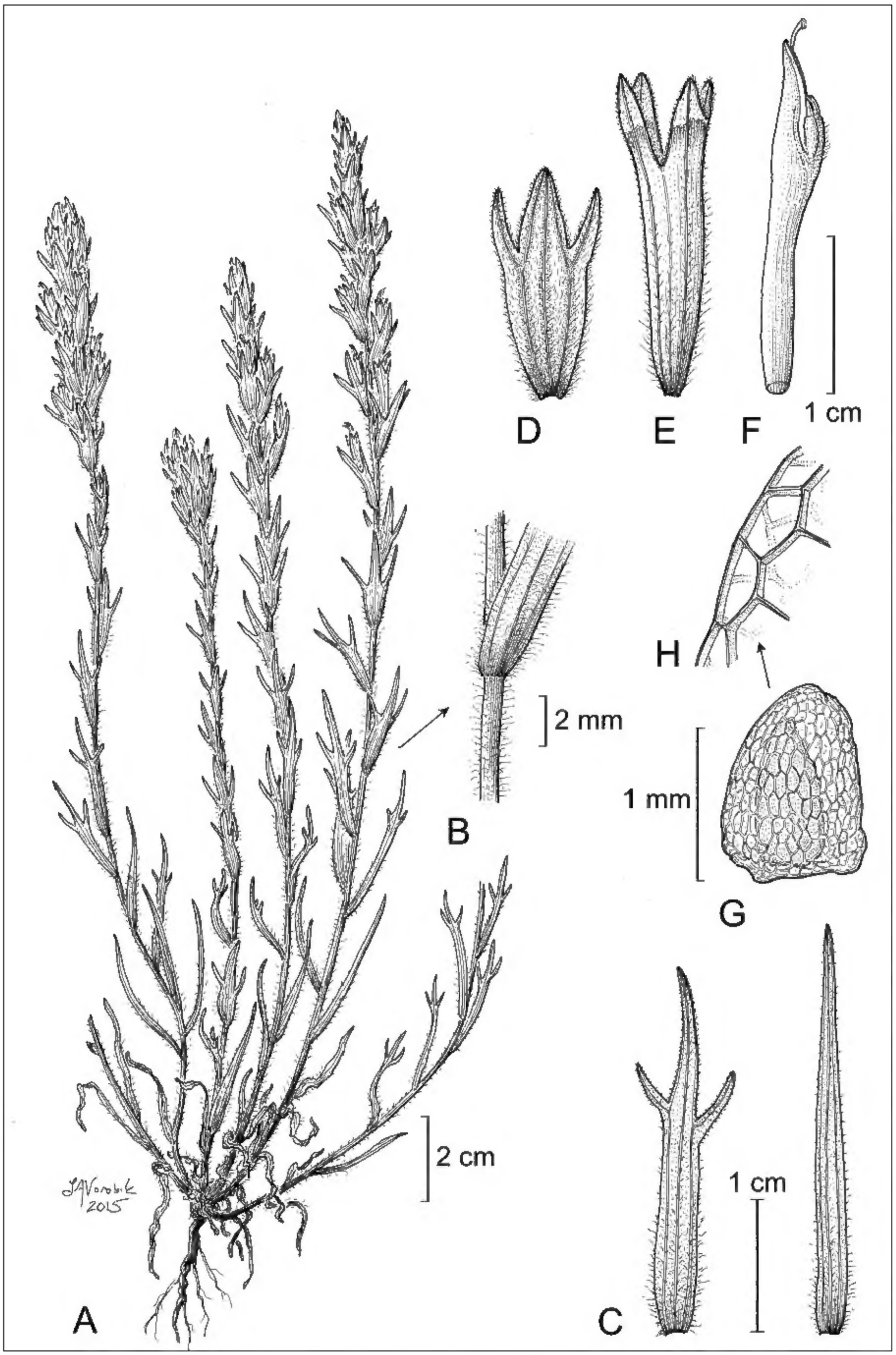

Figure 3. *Castilleja collegiorum*, based on the holotype. A. Habit. B. Close-up of stem. C. Leaves. D. Flower bract. E. Calyx. F. Corolla. G. Seed. H. Close-up of seed coat. Illustration by Linda Ann Vorobik, 2015.

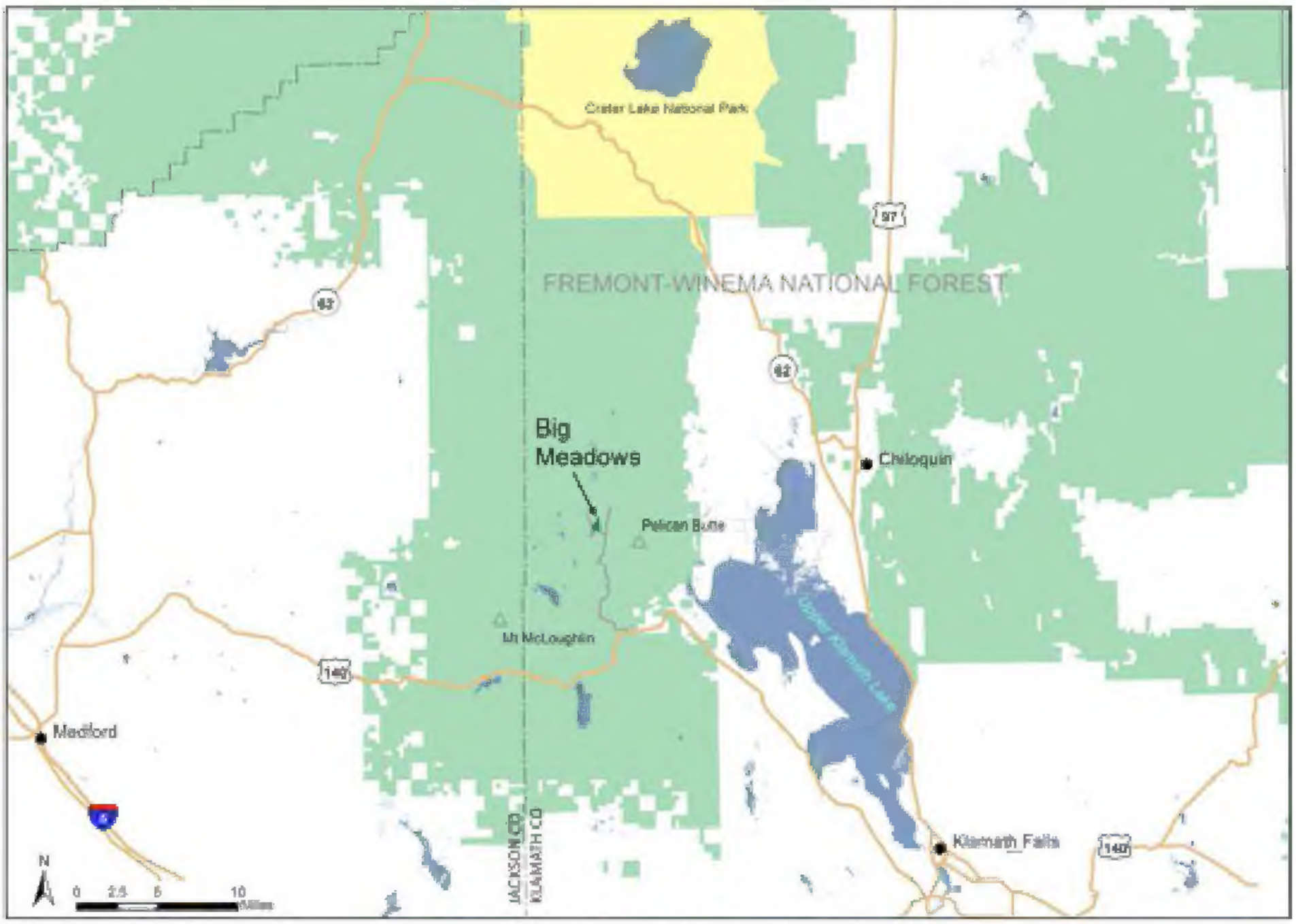

Figure 4. Location of Big Meadows population of *Castilleja collegiorum* in southwestern Oregon.

Figure 5. Aerial photo showing mapped occurrences of *Castilleja collegiorum*, marked in red, within the Big Meadows complex.

Distribution and range

Castilleja collegiorum is presently known from a single population complex at Big Meadows, a meadow system within a forest of lodgepole pine (*Pinus contorta*) consisting of slightly to highly mesic components. Big Meadows is located in the Cascade Mountains of southwestern Oregon at approximately 1725 meters (5660 ft) elevation within the Lost Creek drainage (Figs. 4-5). While searches of additional wet meadow sites in local area have not yielded additional populations, it is possible that additional surveys may reveal their presence.

Ecology, associated species, and phenology

Castilleja collegiorum occurs along the drier but still mesic edges and on slightly raised areas in wet meadows dominated by herbaceous plants (Figs. 6-8). Soils are classified as fine-loamy Humic Cryaquepts, which are deep and poorly drained, with up to 8 cm of organic material over an A horizon consisting of very dark brown mucky diatomaceous silt (Dorr et al. 2008). The meadow is dominated by tufted hairgrass, sedges, and rushes (see species list below), but in areas where *C. collegiorum* is found, there is a diversity of low-growing forb species and scattered *Vaccinium uliginosum*. *Pinus contorta* forest surrounds the meadow. Associated species include *Potentilla breweri*, *Oreostemma alpigenum* var. *andersonii*, *Deschampsia cespitosa*, *Muhlenbergia filiformis*, *Danthonia californica*, *Danthonia intermedia*, *Erythranthe primuloides*, *Pedicularis attollens*, *Polygonum bistortoides*, *Vaccinium uliginosum*, *Trifolium longipes*, *Gentiana newberryi*, *Ranunculus alismifolius*, *Carex nebrascensis*, *Carex capitata*, *Carex simulata*, *Carex pachystachya*, *Carex buxbaumii*, *Juncus balticus*, *Carex luzulina*, and *Pyrrocoma sp.*

Castilleja collegiorum has been observed in flower from 6 July to 26 July. The timing and duration of flowering likely vary annually depending on the depth and persistence of the snowpack and the amount of ponding in the meadows. No potential pollinators, either avian or insect, were noted visiting the flowers of *C. collegiorum* in the field, and we observed little if any evidence of predation on the plants by animals of any sort.

Figure 6. Habitat of *Castilleja collegiorum*, Big Meadows, 15 Jul 2013. The silvery-leaved plant is *Potentilla breweri*, a frequent associate of *C. collegiorum*.

Figure 7. Habitat of *Castilleja collegiorum*, Big Meadows, 15 Jul 2013. Plants occur mostly in left side of the photo, between the trees on the left and the lower, wetter ground on the right.

Conservation status

Castilleja collegiorum appears to have a very limited range and a patchy distribution. However, in sites where its precise habitat requirements are met, plants can be quite densely populated. The current population estimate is roughly 20,000 plants occupying approximately three acres. The known population is located in the Pelican Butte Semiprimitive Recreation Management Area. This area is not presently grazed by livestock and is closed to off-road, wheeled, motorized vehicles. Relatively low levels of dispersed recreation such as snowmobiling, hunting, and camping are its primary uses.

Because *Castilleja collegiorum* appears to have specific hydrologic requirements, long-term droughts and other effects associated with global and regional climate change may adversely affect this species. Future changes in land use management are not anticipated, but increased recreational use or disturbance from off-road vehicles could potentially result in adverse effects on this species. In July 2014, we observed tire tracks and ruts within a portion of the largest meadow, including areas occupied by *C. collegiorum*. For the present, *C. collegiorum* should be considered a range-restricted endemic and managed as a sensitive species, as currently defined by the U.S.D.A. Forest Service rare plant management regulations. Further study of the new species, particularly its range, genetics, and population trends, is recommended. Additional surveys in this portion of the Cascade Mountains should be made at the appropriate season.

Figure 8. Habitat of *Castilleja collegiorum* at Big Meadows, with *Potentilla breweri*, 15 Jul 2013.

Relationships and identification and the status of *Castilleja lassenensis*

With its combination of pale coloration, very short calyx segments, and relatively short corolla beak, *Castilleja collegiorum* is readily placed in sect. *Pallescentes*, as defined most recently by Chuang and Heckard (1991). With its soft pubescence and preference for mesic meadow habitats, it can be further placed within the Chrysanthae, an informal species assemblage utilized by Ownbey (1959) and others. Within that assemblage, *C. collegiorum* most closely resembles *C. lemmonii* in details of the floral morphology and *C. cryptantha* in the patterns of coloration in the inflorescence and in growth form (Figs. 9-10). It seems most likely that *C. collegiorum* is derived from *C.*

lemmonii, both because of the morphological congruencies and the relatively short disjunction between *C. collegiorum* and the nearest known populations of *C. lemmonii*-like plants (see discussion below) in the subalpine meadows surrounding Mt. Lassen in northwestern California, about 220 km to the south. *Castilleja lemmonii* is not known to occur in Oregon. Occasional specimens of *C. lemmonii* are pale-bracted, but most of these variants are pure white or pinkish in coloration and occur as aberrant individuals within larger populations of typically colored plants. In contrast, *C. collegiorum* is very constant in its characters and is easily distinguished by its coloration and morphology and by its more northern range.

The populations of *Castilleja lemmonii*-like plants found in the vicinity of Mt. Lassen represent a unique, disjunct form originally described as *Castilleja lassenensis* Eastw. (Eastwood 1940) (Fig. 10-11). In subsequent years, regional floras have usually placed this name as a synonym of *C. lemmonii*, though it was treated as a full species as recently as the early 1960's (Gillett et. al, 1961). During the examination of specimens in the field and herbarium and photographs of the Mt. Lassen plants for this study, it became evident that these plants have consistent and visually striking differences from the Sierra Nevada populations of *C. lemmonii* and that these differences, together with the disjunct nature of their populations (beyond the northwestern extremity of the range of typical *C. lemmonii*), warrant their formal taxonomic recognition. Recognition of *C. lassenensis* as conspecific with *C. lemmonii* can be seen as emphasizing the probable parent-derivative relationship and the quantitatively low morphometric distinction of *C. lassenensis*, but species vary widely in the nature of their origin and in their degrees of distinction. We treat *C. lassenensis* at specific rank and have included it in the key presented below.

Castilleja lassenensis Eastw., Leafl. W. Bot. 2: 244. 1940. **TYPE**: **USA**. **California**. [Shasta Co.:] On the trail to Bumpas Hell, Mt. Lassen, alt. 7000 ft., 7 Sep 1931, *M.S. Jussel s.n.* (holotype: CAS!).

Castilleja collegiorum has been confused with *C. pilosa* and *C. lemmonii*. It is also similar in coloration and overall aspect to *C. cryptantha*, a rare species known only from the vicinity of Mt. Rainier in the Cascade Mountains of Washington. However, *C. collegiorum* is easily distinguished from those species using the key below. Also included in the key are the following species that occur in southwestern Oregon and adjacent northwestern California that might reasonably be confused with *C. collegiorum*: *C. arachnoidea* A. Gray, *C. attenuata* (A. Gray) Chuang & Heckard, *C. chlorotica* Piper, *C. lacera* (Benth.) Chuang & Heckard, *C. lassenensis*, and *C. tenuis* (A. Heller) Chuang & Heckard.

1. Calyces cleft more or less equally into four subequal lobes; all species annual except *C. arachnoidea* and *C. pilosa* ..... **Castilleja arachnoidea**, **C. attenuata**, **C. lacera**, **C. pilosa**, **C. tenuis**
1. Calyces cleft much more deeply in the abaxial/adaxial direction than laterally; plants perennial from a woody caudex.

2. Leaves of plants with crisped margins; lower lip of corollas expanded, corolla beak prominently curved in the abaxial direction, the expanded margins of which are often reddish and prominent; plants of more xeric substrates ..... **Castilleja chlorotica**
2. Leaves of plants with mostly smooth margins; lower lip of corollas not expanded, corolla beak more or less straight or only very slightly curved in the abaxial direction; plants of seasonally mesic substrates.

3. Inflorescences almost always pink-purple to magenta, occasionally white, noticeably wider than and strongly differentiated from the leafy stem, appearing more or less capitate; cauline leaves mostly entire, though often 3-lobed distally, below the inflorescence; segments of calyces longer, 1.5-3 mm in length; endemic to either Mt. Lassen or to the Sierra Nevada, California and adjacent Nevada.

4. Beak and tube of corollas entirely clear white or white with very pale salmon margins on the beak; lower lip pale green to yellow-green, with white distal teeth; stigmas pale green; proximal 1/2 of calyces pale green, becoming violet-purple only on the distal 1/2; plants endemic to subalpine meadows with volcanic substrates on the flanks of Mt. Lassen .... **Castilleja lassenensis**

4. Beak and tube of corollas greenish on the upper surface with blood red margins on the beak; lower lip greenish with violet-purple distal teeth; stigmas greenish to dark bluish-purple; calyces usually at least pale violet-purple throughout; plants widespread in subalpine meadows with primarily granitic substrates in the Sierra Nevada of California and adjacent Nevada ..... **Castilleja lemmonii**

3. Inflorescences pale cream-white to pale greenish with variable infusions of dull maroon on the bracts and less commonly on the calyces, only slightly wider than and only weakly differentiated from the leafy stem, appearing more elongate and not at all capitate; cauline leaves usually divided into three acute lobes, at least on the distal 2/3 of the stem; segments of calyces shorter, about 1.5 mm or less in length; not found in California.

5. Beak and lower lip of corollas essentially subequal, with the beak exceeding the lower lip by no more than 1 mm; corolla usually included within the calyces and not visible; bracts appearing to be longer than the flowers; leaves larger and broadly lanceolate; plants at least partially self-pollinating; endemic to subalpine meadows on and closely adjacent to Mt. Rainier, Washington ..... **Castilleja cryptantha**

5. Beak of corollas about twice the length of the lower lip; corolla beaks and lower lips often exserted above the calyces, and/or primary calyx lobes spreading to reveal the distal portions of the corolla; bracts appearing to be shorter than the flowers; leaves narrower and linear-lanceolate; pollination system unknown but likely cross-pollinated by bees; endemic to Big Meadows, Klamath Co., Oregon ..... **Castilleja collegiorum**

Figure 9. *Castilleja collegiorum* (left) at Big Meadows, 15 Jul 2013, and *Castilleja cryptantha* (right) at Berkeley Park, Mt. Rainier National Park, Pierce Co., Washington, 23 Aug 1993. Photo of *C. cryptantha* by Mark Egger.

Figure 10. *Castilleja lassenensis* (left), Emerald Lake, Mt. Lassen National Park, Shasta Co., California, 11 Jul 1997, and *C. lemmonii*, Sierra Nevada form (right), Tuolumne Meadows, Yosemite National Park, Tuolumne Co., California, 7 Aug 1993. Photos by Mark Egger.

Figure 11. *Castilleja lassenensis*, Kings Creek Picnic Area, Mt. Lassen National Park, Shasta Co., California, 12 Aug 2004 (left) and 23 Jul 2014 (right). Photos by Dee Warenycia.

ACKNOWLEDGEMENTS

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